

MONROE SIMPLIFIED METHOD FOR EXTRACTING SQUARE ROOT

With the table of factors, the Monroe method of extracting square roots is a simple process of division and can be performed with any model of the Monroe Calculator. It gives accuracy to five significant digits in the root with an error of less than 5 in the sixth digit. On a Monroe Calculator with ten column keyboard, the root can be carried out to ten digits.

INSTRUCTIONS

The Monroe Method

To find \sqrt{n} first determine N' as follows:

For n between 1 and 100 inclusive, take $n = N'$

For n less than 1 or greater than 100, move the decimal point to the right or left in steps of two digits to arrive at N' between 1 and 100.

Find the two consecutive values in the N' column of the table between which N' lies and select the values of A and D between the two selected N' values.

Step 1 Set n on the extreme left of the keyboard and enter as dividend.

Step 2 Set A , from the table, on the extreme left of the keyboard and add.

Step 3 Set D , from the table, on the extreme left of the keyboard and divide.

The result in the upper dials of the Monroe, after decimal is pointed off, is the square root with an error of less than 5 in the sixth digit.

Pointing Off Decimals in Roots

If n is greater than 1, start at the decimal point and working to the left set off n into groups of two digits each. The number of such two digit groups to the left of the decimal point will be the number of digits to the left of the decimal point in the root. If the extreme left-hand group consists of only one figure, it should be counted as though a complete group.

If n is less than 1, start at the decimal point and working to the right set off the zeros preceding the first significant figure into groups of two zeros each. The number of such groups will be the number of zeros that should follow the decimal point and precede the first significant figure in the root. If the last right-hand group consists of only one zero, it should NOT be counted as a group.

Example I

$$\sqrt{6942.3214} = 83.321$$

Step 1 Move decimal in n to left, 69.423214, which is between 69.3 and 70.4 in N' column of table. From table, $A = 69889$ and $D = 1672$.

Step 2 Set 69423214 on the extreme left of the keyboard and enter in the extreme left of the lower dials as a dividend.

Step 3 Set A , 69889 on extreme left of keyboard and add.

Step 4 Set D , 1672 on extreme left of keyboard and divide.

Result Upper dials 833207 or 83321

Inserting the decimal point gives the root, 83.321.

The decimal point in the root is determined by setting off the whole number 6942 into groups of two digits each, 69'42. Since there are two groups, there are, according to the rule, two whole number digits in the root, thus 83.321.

Example II

$$\sqrt{0.000003912} = 0.0019779$$

Step 1 Move decimal in n to right, 3.912. From table, $A = 3863$ and $D = 3931$.

Step 2 Set 3912 on extreme left of the keyboard and enter in the lower dials as a dividend.

Step 3 Set 3863 on extreme left of the keyboard and add.

Step 4 Set 3931 on extreme left of the keyboard and divide.

Result Upper dials 1977868 or 19779

Inserting the decimal point gives the root 0.0019779. The decimal point is determined by counting the number of full pairs of zeros to the immediate right of the decimal point in 0.00'00'03912. Since there are two such pairs of zeros (disregard the fifth zero) two zeros should follow the decimal point and precede the first significant figure of the root, thus 0.0019779.

Example III

$$\sqrt{207.08425} \text{ to ten significant figures} = 14.39042217$$

Step 1 Move decimal in n to left, 2.0708425. From table, $A = 2042$ and $D = 2858$.

Step 2 Set 20708425 on extreme left of keyboard and enter as a dividend.

Step 3 Set 2042 on extreme left of keyboard and add.

Step 4 Set 2858 on extreme left of keyboard and divide.

Result Upper dials 143906 or 14.391, root to five significant figures

To carry out to ten significant figures, continue as follows:

Step 5 Clear upper and lower dials. Disregarding decimal, set radicand 20708425 on extreme left of keyboard and enter as dividend.

Step 6 Set 14391, root to five places without decimal, on extreme left of keyboard and divide.

Result Upper dials 1438984434

Step 7 Average 1438984434 with the first approximation, 14391, by adding 1438984434 and 14391 with the left-hand digits aligned to obtain the total, 2878084434, and divide that figure by 2.

Result Upper dials 1439042217, when pointed off, 14.39042217, root with maximum possible error of 1 in the tenth place

MONROE INTERNATIONAL, INC.

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MONROE TABLE OF FACTORS FOR
SIMPLIFIED METHOD FOR EXTRACTING SQUARE ROOT

For accuracy to five significant digits in roots with an error of less than 5 in the sixth digit


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N'	A	D	N'	A	D	N'	A	D	N'	A	D
1.000			6.29			19.2			47.35		
1.045	102	202	6.49	6383	5053	19.55	1932	8791	48.0	47679	1381
1.09	1067	2066	6.69	6579	513		1978	8895	48.0	48302	139
1.14	1114	2111	6.905	6791	5212	20.0	2016	898	48.75	4914	1402
1.19	1162	2156	7.132	7017	5298	20.3	2043	904	49.5	4985	14121
1.24	1211	2201	7.35	7244	5383	20.65	2088	9139	50.35	5073	14245
1.28	126	2245	7.56	745	5459	21.0	211	9187	51.1	5148	1435
1.327	1303	2283	7.80	7681	5543	21.3	2152	9278	51.8	522	1445
1.385	1356	2329	8.05	7924	563	21.7	2186	9351	52.7	5318	14585
1.45	1416	238	8.285	8168	5716	22.1	2233	9451	53.6	54022	147
1.515	1481	2434	8.53	8404	5798	22.5	227	9529	54.5	54908	1482
1.575	1545	2486	8.795	8661	5886	22.95	2316	9625	55.2	55502	149
1.645	1609	2537	9.00	8922	5974	23.3	2343	9681	56.0	564	1502
1.705	1677	259	9.24	9102	6034	23.6	2379	9755	56.83	5738	1515
1.777	1741	2639	9.485	9345	6114	24.0	2427	9853	57.9	5843	15288
1.855	1817	2696	9.77	9619	6203	24.55	248	996	59.0	59444	1542
1.94	1896	2754	10.0	9894	6291	25.0	252	1004	59.85	6038	15541
2.01	1974	281	10.2	1009	6353	25.5	2574	10147	60.95	61465	1568
2.08	2042	2858	10.45	1032	6425	26.0	2626	10249	62.0	6252	15814
2.16	2114	2908	10.6	1053	649	26.55	26832	1036	63.1	636	1595
2.222	2177	2951	10.8	1066	653	27.1	2741	10471	64.0	644	1605
2.29	2259	3006	11.0	1086	6591	27.72	27984	1058	65.0	6548	16184
2.38	2327	3051	11.2	11122	667	28.25	2851	10679	66.0	66585	1632
2.47	2421	3112	11.5	1136	6741	28.8	29052	1078	67.2	6765	1645
2.57	252	3175	11.7	1157	6803	29.3	2955	10872	68.25	6879	16588
2.676	2621	3238	11.9	1183	6879	29.8	3003	1096	69.3	69889	1672
2.78	2729	3304	12.1	1202	6934	30.2	3047	1104	70.4	7098	1685
2.885	2829	3364	12.3	1218	698	30.8	31136	1116	71.4	7191	1696
2.99	2936	3427	12.5	1245	7057	31.45	31753	1127	72.5	73102	171
3.09	3038	3486	12.75	1262	7105	32.05	3237	11379	73.73	7439	1725
3.22	3154	3552	12.9	1287	7175	32.7	33062	115	75.0	7549	17377
3.352	3285	3625	13.2	1305	7225	33.44	33698	1161	76.0	76562	175
3.457	3404	369	13.4	13286	729	33.9	34222	117	77.2	7788	1765
3.59	3523	3754	13.7	1352	7354	34.6	3491	11817	78.5	79032	1778
3.71	3648	382	13.9	1379	7427	35.2	35402	119	79.5	80102	179
3.80	3777	3887	14.1	1401	7486	35.78	3606	1201	80.6	8109	1801
3.94	3863	3931	14.3	1419	7534	36.3	36602	121	81.6	8221	18134
4.05	3996	3998	14.5	1436	7579	37.0	37271	1221	82.8	8321	18244
4.13	4056	4028	14.7	146	7642	37.5	37822	123	83.7	8418	1835
4.26	4188	4093	15.08	1488	7715	38.2	38502	1241	84.6	851	1845
4.40	432	4157	15.45	1528	7818	38.8	39062	125	85.5	8584	1853
4.54	4471	4229	15.8	1563	7907	39.4	3974	12608	86.4	8689	18643
4.705	4618	4298	16.0	1596	799	40.0	40322	127	87.4	8789	1875
4.87	4785	4375	16.35	1616	804	40.7	4103	12811	88.3	8883	1885
5.035	4946	4448	16.7	1652	8129	41.45	41796	1293	89.4	8968	1894
5.225	513	453	17.1	169	8222	42.1	4251	1304	90.0	9044	1902
5.39	5306	4607	17.35	1721	8297	42.9	4323	1315	91.0	9168	1915
5.56	5459	4673	17.75	1756	8381	43.7	4389	1325	92.1	9264	1925
5.74	565	4754	18.05	1788	8457	44.3	44689	1337	93.3	9406	19397
5.93	5832	483	18.4	1819	853	45.0	4536	1347	94.6	9516	1951
6.12	6017	4906	18.8	1858	8621	45.7	4609	13578	95.75	9653	1965
6.29	62	498	19.2	1897	8711	46.5	46922	137	97.1	9792	19791
	6383	5053		1932	8791	47.35	47679	1381	98.6	994	1994
									100.0		

See reverse for instructions for the use of this table

Form 1228-S

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